pipe for circulating absorption liquid. The branch pipe extends into a collection tank through the wall of the collection tank. The discharge end of the branch pipe discharges the circulating absorption liquid into absorption liquid in the collection tank. Finally, the branch pipe has an internal diameter D. An air-blowing pipe is provided to inject air into the branch pipe and is inserted into the branch pipe so that the central axis of the air-blowing pipe meets the central axis of the branch pipe at an angle. One end of the air-blowing pipe opens in the branch pipe and is configured as a semicircular trough facing downstream towards the collection tank. The insertion point of the air-blowing pipe into the branch pipe is between 3D and 10D from the discharge end of the branch pipe.

Claim 4 depends from Claim 1 and adds that the end of the air-blowing pipe which is inserted in the branch pipe has an internal diameter of about 0.4D to 0.7D.

Tamaru discloses a wet-gas desulfurizing device for absorbing sulfur oxide of an exhaust gas with an absorption liquid. As indicated in the Office Action,

> ... Tamaru is silent as to the instantly recited structure of the insertion point **13**, requiring the air-blowing pipe **14** to be inserted into the branch pipe **12** so that a central axis of the air-blowing pipe **14** meets with a central axis of the branch pipe **12** at an angle, and requiring an end of the air-blowing pipe **14** which opens in the branch pipe **12** to be configured as a semicircular trough facing downstream towards the collection tank **4**.

Tamaru teaches a system similar to that described in the Technical Background section of the present disclosure. See the Specification, page 2, lines 6-12, and Fig. 14. See the Specification, page 3, lines 3-7. As shown in Fig. 14 of the present application, auxiliary pipe 118 which circulates the absorption liquid

in collection tank 102 has a separate circulation pump 118b. Another pipe 118a is provided on pipe 118 to inject air so that a mixture of air and liquid is formed in pipe 118. Agitator 119 is used to disperse the air through all parts of the collection tank 102. The agitator 119 is required to maintain efficient oxygenating capacity and to prevent the accumulation of sediments produced by oxygenation. Problems arise because the equipment required for such an agitator is expensive and bulky, as explained in the Specification. This is system is discussed in paragraph [0019] of Tamaru, describing an impeller 8 driven by a motor 9 which causes a flow of liquid and agitation of the solution. Use of the agitator is also referenced in paragraphs [0020] - [0024], [0031] - [0032] and [0035] of Tamaru.

The present invention solves this problem by use of a novel insertion point of the air-blowing pipe into the branch pipe. In particular, the air-blowing pipe is inserted into the branch pipe between 3D and 10D from the discharge end of the branch pipe. Further, the end of the air-blowing pipe which opens in the branch pipe is configured as a semicircular trough facing downstream towards the collection tank.

Tamaru provides no teaching or suggestion that the location of insertion of the air-blowing pipe into the branch pipe is between 3D and 10D from the discharge end of the branch pipe. Moreover, Tamaru does not teach or even suggest that there may be any benefit provided by inserting the air-blowing pipe at one location on the branch pipe or another, much less that the location of the

air-blowing pipe may be critical. Further, Tamaru does not describe that the air-blowing pipe is shaped as a semicircular trough facing downstream as it opens in the branch pipe. Finally, as indicated in the Office Action, Tamaru does not teach that the air-blowing pipe is inserted in the branch pipe so that a central axis of the air-blowing pipe meets a central axis of the branch pipe at an angle.

Johnson relates to a pressure spray cleaning device. First of all, as acknowledged in the Office Action, there is no air-blowing pipe which inserts into a branch pipe, as is recited in claim 1. Rather, a pipe carrying a liquid 31 attaches to a metering valve 35, which has an outlet portion 36 opening inside an enlarged mixing chamber 26. See Johnson col. 2, lines 52-66. Thus, Johnson teaches a liquid carrying branch pipe which opens into a mixing chamber, rather than an air-blowing pipe which opens into a liquid carrying pipe. This is a significant difference. The dynamics of mixing fluids are most certainly affected by the different characteristics of the fluids to be mixed, such that blowing a gas, (here air), into a liquid would be expected to have very different properties than delivering a liquid into moving stream of gas (air).

Examination of the figures and related specification of Johnson makes instantly obvious that insertion point of the air-blowing pipe into the branch pipe is not located between 3D and 10D from the discharge end of the branch pipe. First of all, there is no insertion of an air-blowing pipe into a liquid-carrying branch pipe. However, even assuming, *arguendo*, that the insertion of the liquid-carrying pipe through a metering valve into a moving airstream were remotely

similar to the insertion of the air-blowing pipe into a liquid-carrying pipe, the metering valve of Johnson is inserted into the mixing chamber well beyond 10D from the discharge end of the system. In particular, see Fig. 1, which shows nozzle 22 with an elongated rigid pipe or conduit 39 which has a spray tip 40 affixed on the end. (Johnson specification, col. 3, lines 14-15.) This elongated rigid pipe serves as a wand so that the liquid exits the pressure spray cleaning device near the spot of the cleaning. As a result, the distance between the insertion point and the discharge end is likely at least an order of magnitude larger than 10D. Moreover, the device shown by Johnson includes joining of the mixture resulting from the mixing chamber with a third pipe or conduit 39, through valve 48 attached to a reducing sleeve 50 and a jet nozzle 51. This is another significant difference between the claimed system and that taught by Johnson, since this indicates that the mixture from the mixing chamber is further modulated by passage through a jet nozzle for combining with another solution (hot water or other diluent) provided by hose 46.

For these reasons, the pressure washer of Johnson is not at all like the wet gas desulfurizing device presently claimed. Given the differences in these systems and their purposes, a person of skill in the art would be unlikely to try to combine the teachings of Johnson with Tamaru. This is especially true given that Johnson involves introducing a liquid into a gas stream, while desulfurizing devices involve introducing a gas stream into a liquid. Thus, not only is there no suggestion or motivation provided in either reference to try to combine their

teachings, given that they operate altogether differently from one another (Tamaru involves introducing gas into liquid, while Johnson involves introducing liquid into a gas stream), one of skill in the art would be discouraged from even attempting the combination.

Even assuming, *arguendo*, the combination were attempted, neither reference teaches the introduction of a gas stream into a liquid-carrying pipe at a point between 3D and 10D from the discharge end of the liquid-carrying pipe. In fact, neither reference teaches that the distance between the insertion point and discharge end is at all critical or might have any bearing on the operation of the system. Thus, locating the insertion point between 3D and 10D is not merely a result of discovering the optimal or workable ranges for the system. Rather, it involves first determining that there are disadvantages associated with using agitators such as those taught by Tamaru and second that these disadvantages can be overcome, in part, by locating the insertion point between 3D and 10D from the discharge end. Creation of a system that facilitates removal of what were previously considered critical parts is a task far greater than simply optimizing the system.

Further, neither Tamaru or Johnson describes an air-blowing pipe shaped as a semicircular trough facing downstream as it opens in a liquid-carrying pipe. Finally, neither Tamaru or Johnson teach that the air-blowing pipe is inserted in the liquid-carrying pipe so that a central axis of the air-blowing pipe meets a central axis of the liquid carrying pipe at an angle.